XXXIV.—*On the Classification of the* Striges. By Frank E. Beddard, M.A., F.Z.S., Prosector to the Zoological Society of London.

There are three important works which deal with the classification of the Striges from the anatomical standpoint. The first of these is the treatise on Pterylography by Nitzsch*. In this work Nitzsch describes the arrangement of the feather-tracts in a large number of Owls, and concludes that the group is separable into two well-marked divisions. One of these includes the genera *Strix* (termed by Nitzsch *Hybris*) and *Photodilus*, which is not separated generically from *Strix*; to the other group he referred all the remaining genera of Striges. Prof. A. Milne-Edwards, in his 'Oiseaux fossiles de la France,' gave a detailed osteological account of the Striges, and showed that Nitzsch was justified in separating *Strix* from the rest†. Some years later M. Milne-Edwards‡ published an illustrated account of the skeleton of *Photodilus badius*, and pointed out that this Owl must be regarded as intermediate in position between the Strigidæ and Bubonidæ; the pterylographical characters are those of *Strix*, while the osteology agrees with *Bubo* and all other known genera except *Strix*. In the same memoir M. Milne-Edwards described the osteology of a Madagascar genus, *Heliodilus*; this account is repeated, with illustrations, in a later work §. The description and figures prove that *Heliodilus* is a near ally of *Strix*.

The more important osteological characters which separate the Strigidæ from the Bubonidæ are recapitulated by Prof. Newton in the 'Encyclopædia Britannica' ||. They are briefly

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* Pterylography. English edition, by P. L. Sclater. Ray Soc.

† Prof. Newton (Yarrell's 'British Birds,' 4th ed. vol. i. p. 148) states that Messrs. Sclater and Salvin had already divided the Strigidæ into two families distinguished by the characters of the sternum.

‡ Nouv. Arch. d. Mus. sér. 3, t. i. (1878).

§ Grandidier & Milne-Edwards, 'Histoire Phys. Nat. et Polit. de Madagascar, Oiseaux.' Mr. Sharpe (P. Z. S. 1879, p. 175) has pointed out that in the serration of the middle claw *Heliodilus* agrees with *Strix*.

|| Article "Owl," vol. xviii. p. 88.

stated at the end of this paper (p. 340), with the addition of others, of which I can find no particular description in the memoirs cited.

1. *Skull.*—The most obvious characters which distinguish the skull of *Strix* from that of the remaining genera have been pointed out by Milne-Edwards*; they are, *firstly*, the greatly elongated and narrow form of the skull in *Strix* contrasted with the wide short skull of other types; *secondly*, the relatively great thickness of the bones which make up the interorbital septum in *Strix* as compared with the extremely thin interorbital septum of other Owls.

I find by a series of measurements of the skulls of the following types:—

Strix flammea,
Strix sp.,
Asio mexicanus,
Speotyto cunicularia,
Athene noctua,
Bubo maximus,
Bubo bengalensis,
Syrnium indranee,
Syrnium woodfordi,
Ketupa javanica,
Sceloglaux albifacies,
Nyctea nivea,

that while *Strix* has the narrowest skull (the proportion of greatest breadth to length being in *Strix* sp. inc. as 37·5 : 62, in *Strix flammea* 36 : 56), the other genera show a progressive widening of the skull; this culminates in *Speotyto cunicularia*, where the breadth is to the length as 37 : 38. I do not give the exact measurements in the other species mentioned in the present list for the reason that such a table of measurements would only be of value if it embraced the results of a study of a larger number of species and of individuals. I may state, however, that I have examined a large number of Owls' skulls in the British-Museum collection, including those of two other species of *Strix* (viz. *S. perlata* and *S. delicatula*), and in no case do I find so long and narrow a skull as in the genus *Strix*. It may be worth while mentioning that *Sceloglaux albifacies* has a skull which comes nearer to that of *Strix* in its relative proportions than do the skulls of many other genera. The reason which leads me to lay some stress upon this fact is the opinion of Prof. Newton* that this curious Owl may prove to be intermediate between the Strigidæ and other Owls. I hope, however, to be able, at some future time, to compare the skeleton of *Sceloglaux* with that of *Strix.*

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* Nouv. Arch. &c. p. 189.

Prof. Milne-Edwards, in his memoir upon *Photodilus*, shows plainly that this genus belongs to the Bubonine and not to the Strigine group in the proportions of the skull and in the possession of a flattened interorbital septum.

There is one feature in the skull of the Striges, serving to distinguish the Strigidæ from the Bubonidæ, which has apparently escaped the attention of Prof. Milne-Edwards.

Fig. 1.

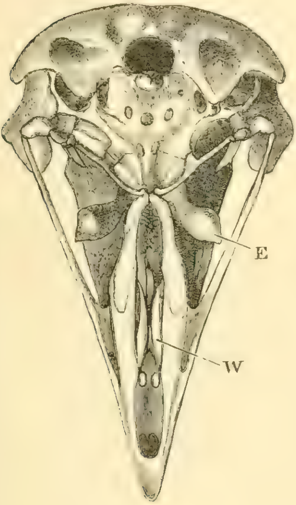

Fig. 2.

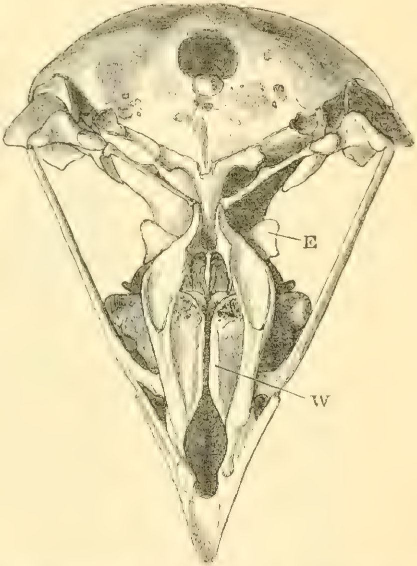

Fig. 1.—Under surface of the skull of *Strix flammea.* E. Prefrontal processes of the ethmoid; W. Maxillo-palatines.

Fig. 2.—Under surface of the skull of *Bubo bengalensis.* (Lettering as in fig. 1.)

In *Strix* (woodcut, fig. 1) the prefrontal processes of the ethmoid are rounded and much swollen. In *Bubo* (fig. 2), and in all other genera of Owls which I have had the opportunity of studying, the same processes are thin, leaf-like expansions*, as they are in the Accipitres Diurnæ. With regard to the other points of difference in the skull, I must refer the reader to Prof. Milne-Edwards's memoir; the principal points are indicated in the table on p. 340 of this paper.

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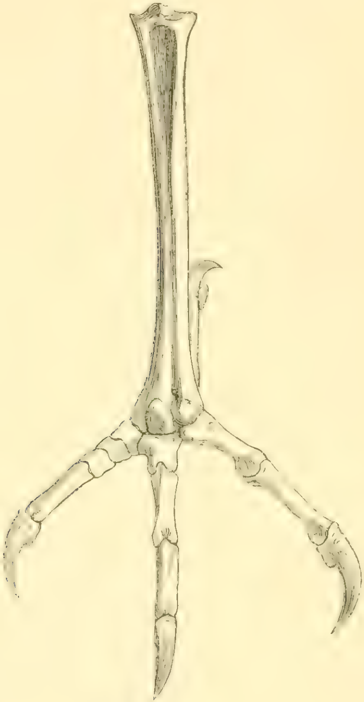
* Encycl. Brit., art. "Owl."

Fig. 3.



Right foot of *Strix flammea* (nat. size).

2. *Sternum.* The characters of the sternum and of the other parts of the skeleton have been so fully described by

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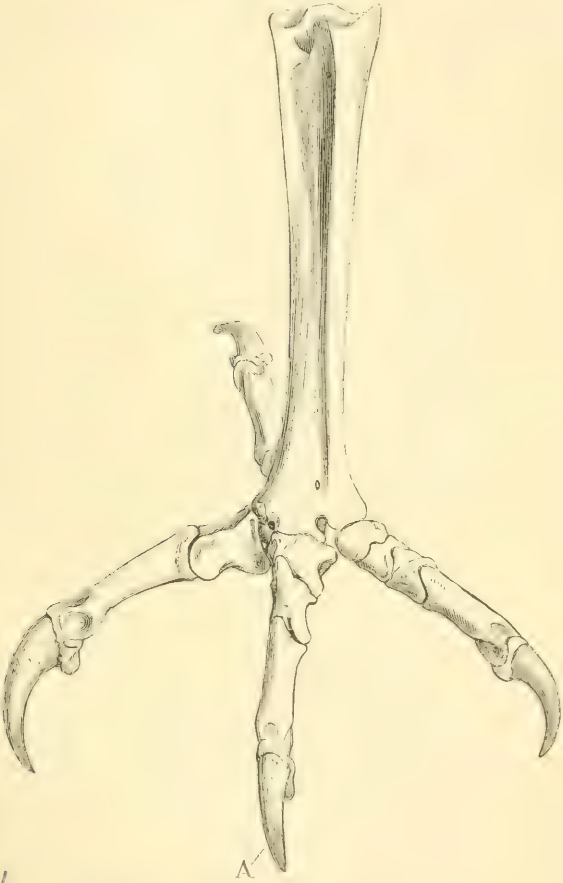
[*] I am disposed to think, from the illustrations of *Heliodilus* given by Milne-Edwards ('Histoire Phys. Nat. et Polit. de Madagascar, Oiseaux,' Atlas i. pl. 36*c*. fig. 1), that the ethmoid processes of this Owl resemble those of *Bubo* rather than those of *Strix*.

Milne-Edwards that I find myself unable to add anything to what he has said, except with regard to the bones of the foot.

3. *Foot.*—A comparison of the relative length of the phalanges of the third digit appears to afford another character for the discrimination of the Striginæ and Buboninæ.

In *Strix* (fig. 3, A) the first phalanx of that digit is markedly shorter than the second phalanx.

Fig. 4.



Left/ ~~Right~~ foot of *Bubo bengalensis* (nat. size).

In *Bubo* (fig. 4, A) and in the other genera the two phalanges in question are subequal.

Applying this test to *Heliodilus*, it confirms the justice of Prof. Milne-Edwards's views of the affinities of that bird. In the illustration of the skeleton which he gives, it is quite obvious that the proportions of the two first phalanges of the third digit are those of *Strix*.

The illustration of *Photodilus* is not sufficiently accurate to admit of a statement with regard to this point. The skeleton was apparently defective.

The principal osteological characters of the genus *Strix*, and which apparently distinguish it from all others, are the following:—

(1) The skull is relatively long and narrow.
(2) The palatines are straight, nearly parallel to each other; they are of approximately the same width throughout; they almost conceal the underlying maxillo-palatines, which are broader from above downwards than from side to side.
(3) The prefrontal processes of the ethmoid are rounded bones of some width.
(4) The interorbital region of the skull does not form a thin plate anteriorly, but is of considerable width from side to side.
(5) The sternum has but one notch on either side.
(6) In the foot the second joint of the third toe is considerably longer than the basal joint.
(7) There is no bony ridge upon the tarso-metatarsus.

On the other hand, in the Bubonidæ the skeleton has the following characters:—

(1) The skull is relatively broad and short.
(2) The palatines are curved, the hinder part of the bone being much wider than the anterior region; the maxillo-palatines are very broad from side to side.
(3) The prefrontal process of the ethmoid is a thin plate*.

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* In *Athene noctua* and *Speotyto cunicularia* these processes are very small, and are hidden by the palatines when the skull is viewed from the ventral surface. The skull is broader in these two genera than in any others examined by me, and the maxillo-palatines are smaller.

(4) The interorbital plate is thin and often fenestrated.
(5) The sternum has two notches on either side.
(6) In the foot the second joint of the third digit is subequal in size to the basal joint.
(7) There is a bony ridge upon the under surface of the upper end of the tarso-metatarsus.

4. *Tensores patagii.*—I take this opportunity of noting certain points in the structure of the muscles and syrinx which are quite in harmony with the division of the Striges into two families, Strigidæ and Bubonidæ. With regard to the muscles I have to call attention only to the *tensor patagii brevis* and to the *tensor patagii longus.* In *Bubo* the *tensor patagii brevis* splits into two tendons, which are inserted on to the fascia of the muscles arising from the elbow. In *Strix flammea* these tendons are more complicated; the *tensor patagii brevis* gives rise to two tendons; the inner of these tendons branches, the outer branch fusing with the outer tendon; from the point where the inner branch joins the fascia covering the elbow-muscles a thin tendon passes obliquely through the patagium to join the tendon of the *tensor patagii longus.* This oblique tendon occurs in *S. flammea* and *S. pratincola* and (according to a MS. sketch of Prof. Garrod) in *S. novæ hollandiæ*; it does not occur in any other Owl which I have dissected, viz. *Bubo maculosus, Scops leucotis, Pulsatrix torquata, Athene noctua, Syrnium aluco, S. nebulosum, Otus vulgaris, Ketupa javanensis,* and *Nyctea nivea.* For the present, therefore, there is this difference between the Strigidæ and the Bubonidæ; and although it is undoubtedly a small difference, its constancy makes it of some importance.

As the object of the present paper is not to give an account of the anatomy of the Striges, but to distinguish the two families Strigidæ and Bubonidæ, I have not indicated the numerous minute points of difference in the disposition of the *tensores patagii* in the various genera of Bubonidæ.

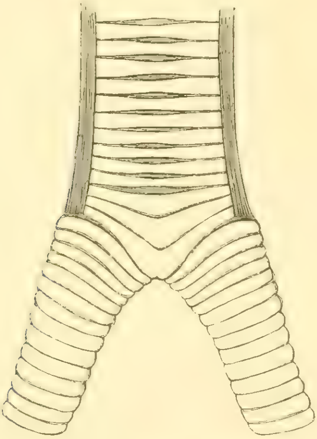
5. *Syrinx.* I have examined this organ in the following genera and species:—

Strix flammea.
Ketupa javanensis.
Bubo virginianus.
Bubo maculosus.
Bubo capensis.
Syrnium indranee.
Syrnium aluco.
Asio otus.
Nyctea nivea.
Glaucidium passerinum.
Speotyto cunicularia.
Pulsatrix torquata.
Otus brachyotus.
Scops leucotis.
Gymnoglaux nudipes.

In all these species the *sterno-tracheal* muscles are very stout, and there is but a single pair of *syringeal* muscles. The *syrinx* itself is tracheo-bronchial, though there are indications in several genera (particularly in *Scops*) of a passage towards a bronchial syrinx, such as is found in certain Cuckoos[*] and Goatsuckers[†].

The principal difference which I have found to distinguish the syringes of the various genera of Owls concerns the insertion of the intrinsic muscles, that is, their distance from the bifurcation of the trachea. *Strix* (fig. 5) possesses a typical tracheo-bronchial syrinx. The last tracheal rays are

Fig. 5.



Syrinx of *Strix flammea.*

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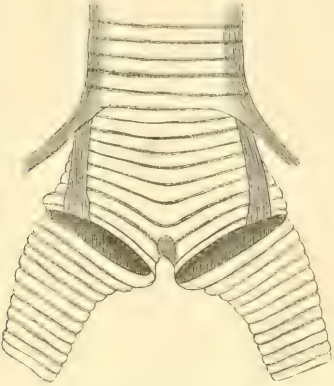
[*] Beddard, "On the Structure and Classification of the Cuckoos," P. Z. S. 1885, p. 168.

[†] Beddard, "On the Syrinx &c. of the Caprimulgidæ," P. Z. S. 1886, p. 147.

fused at their lower extremities and form a triangular piece. The first bronchial semiring is a stout arched bar, which is entirely ossified, and to this is attached the syringeal muscle; the remaining bronchial semirings are cartilaginous.

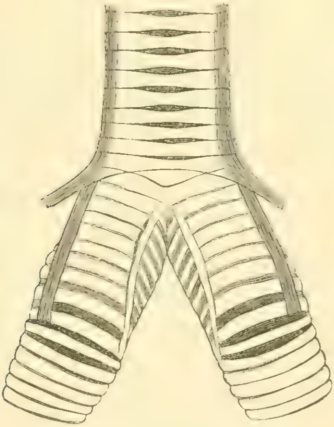
Fig. 6.



Syrinx of *Bubo maculosus.*

The syringes of *Bubo* (fig. 6), *Syrnium,* and *Asio* come nearest to that of *Strix*: in all of these the attachment of the syringeal muscles is apparently the same as in *Strix*; but the fact that

Fig. 7.



Syrinx of *Scops leucotis.*

a varying number of tracheal rings are incomplete in front as well as behind, instead of being complete anteriorly, as in *Strix*, makes it appear as if the attachment of the said muscles had moved further down the bronchi. Of the above-mentioned types *Asio* is furthest removed from *Strix*; there are seven tracheal rings intervening between the last complete one and the first bronchial which bears the muscles.

This modification of the syrinx culminates in *Scops leucotis* (fig. 7, p. 343), where the syringeal muscles are attached to the tenth semiring.

There is thus a gradual series (which would probably be more complete could I report upon a larger collection of syringes) leading from *Strix* to *Scops*.

As the series is gradual, it is impossible to make a break anywhere, although the extremes, viz. *Scops* and *Strix* (*cf.* figs. 5 & 7), are different enough.

In view of the object of the present paper (that is, of establishing the justice of dividing the Striges into two groups), I may point out that the structure of the syrinx, although it would not be sufficient, if considered by itself, to justify such a classification, is by no means contradictory to it.

XXXV.—*On the Birds observed by Dr. Bunge on his recent Visit to Great Liakoff Island.* By Henry Seebohm.

For a period of five years, from 1882 to 1887, many interesting observations were made by Dr. Bunge in North-east Siberia. The results of his visit to the delta of the Lena were published in the 'Mélanges Biologiques tirés du Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg,' xii. livr. i. pp. 31–107, of which a *résumé* may be found in the 'Transactions of the Norfolk and Norwich Naturalists' Society,' iv. pp. 301–305. The record of Dr. Bunge's observations in Great Liakoff Island is to be found in the 'Beiträge zur Kenntniss des Russischen Reiches und der angrenzenden Länder Asiens,' iii. pp. 231–283.

Dr. Bunge crossed the ice from the mainland to Great